Mapping Invasive Species Using Imaging Spectrometry

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ABSTRACT

Invasive plant species are recognized to be a severe threat to environmental sustainability altering biogeochemical cycles and disturbance regimes. The development of airborne and spaceborne imaging spectrometers permits more detailed mapping of plant communities and species based on physical principles. This study used NASA's Advanced Visible Infrared Imaging Spectrometer (AVIRIS), a 224-band instrument with nominally 10 nm contiguous bands over the 400-2500 nm range and acquired at ~4 m pixel resolution. Where there are sufficient differences in chemical composition and canopy/stand structure it is possible to identify some weed species against a vegetated background. We present case studies on the detection of invasive weeds using the AVIRIS airborne imaging spectrometer for several sites in the western U.S. AVIRIS species classifications were predominantly related to important physiological properties, including concentrations of chlorophyll, water and canopy dry matter. Here we present maps of several invasive species, including Cheatgrass, Fennel, Giant Reed, Iceplant, Leafy Spurge, Pampas Grass, and Tamarisk from a range of habitats in California, Washington, North Dakota, and Arizona. Each site represents a different suite of environmental conditions and habitats for invasive weeds. Calibration of the AVIRIS data to surface reflectance utilized a radiative transfer code based on MODTRAN and field targets. Mapping was demonstrated using multivariate techniques like Minimum Noise Transform, regression based techniques, and biophysical indices. Validation of vegetation mapping and land cover results were based on GPS field surveys and field spectrometry. Dominant weeds were mapped at various densities, down to <25% of the total plant cover. We demonstrate the application of imaging spectrometry techniques for mapping invasive weeds in various semi-arid rangelands and compare portability of methods under different conditions and ecosystems.